

National Program 306 – Quality & Utilization of Agricultural Products
Assessment Report

March 4-5, 2008

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The NP 306 Assessment Review Team (Team) assembled March 4-5, 2008 at the Marriott Residence Inn-Greenbelt to assess the impacts and relevance of the National Program. The Team analyzed 162 accomplishment reports in this two-component program. Seven problem areas containing a total of 23 objectives were reviewed. Each problem area was rated for relevance and impact and comments were directed at each of the 23 objectives.

The Team wishes to thank the ARS staff for assembling the information in a form that was easily utilized. To begin, the Team offers some comments regarding the overall process of retrospective accomplishment review, then general comments on the NP 306 National Program, and finally specific comments on each of the seven program areas.

Before the Team offers specific comments on the accomplishment reports it examined, the Team was impressed with the productivity of the National Program. Clearly the opportunity to transform research into economic activity is evidenced by the large number of CRADAs generated in this National Program. Finally, the Team compliments the National Program for its efforts to engage stakeholders in defining the research program that should be supported with public funding through ARS.

Comments on the Assessment Review Process:

1. The Team assessed not only the impact of each accomplishment but also chose to rank the relevance of the project. A ranking scheme of high, moderate and low relevance was used based on what the Review Team felt was the importance of the research to the respective stakeholders and to the knowledge base in the area. The ranking was translated into a numerical score with 5 indicating high relevance and 1 indicating low relevance. The Team suggests that in future assessment reviews the Review Team be asked to assess the relevance of the research to the area.
2. The Team suggests that a standard reporting format be developed and strictly implemented for principle investigators so that the accomplishment reports have some consistency of data and information for the Assessment Team. Such a template would request information on: (1) relationship to the objective(s) of the program area, (2) clear statement of the problem being addressed by the research, (3) role of stakeholders in identifying the research needs, (4) accomplishments of the research in terms of the science, and (5) accomplishments of the research in adoption and commercialization of the science and/or technology.
3. Accomplishments were presented using an organization around the seven problem areas. There are other ways to view the research e.g. (1) commodity (e.g. citrus, dairy, meat, soybeans, corn, cotton, leather, etc.), (2) technology (e.g. Near Infrared Spectroscopy), and (3) stakeholder group. Listing the accomplishments around some of these topics could be useful to the Team.
4. The accomplishment reports should indicate where there is collaboration between ARS scientists at different locations working on related commodities (e.g. working on citrus related problems).
5. When a method is the accomplishment of the research, there should be a detailed description of the method, especially the basis, so that the significance of the research can be assessed. Data should include a statistical comparison to existing methods.
6. When the accomplishment reports an improvement over existing technology, data need to be sufficiently inclusive so that a comparison can be made between existing and new technology. For example, reporting a 26% improvement in yield of a particular component may not be significant if the yield increases from 1% to 1.26%. However, it could be very significant if the yield increases from 10% to 12.6%.
7. When the accomplishment has resulted in a change within the industry, where possible a financial value to producers or consumers should be placed on the improvement.

8. In a report where a technology has been adopted, there should be a statement as to the current and continued use and adoption of the technology.

Comments on NP-306:

1. It was obvious from the accomplishments reports that the leather and cotton industry stakeholders were heavily involved in identifying the research agenda. The method of obtaining this industry input into the research priorities could be emulated by other commodity groups because it was evident that such research in general had high relevance and high impact.
2. The Team was encouraged that in 2003 the program arranged a Planning and Coordination Workshop for ARS scientists working on the same commodities. The purpose of the workshop was to review and coordinate the research program. In the accomplishments reports dealing with a particular commodity area, it would be appropriate to have evidence that the ARS scientists have met to discuss the total research effort toward that commodity.
3. There are several accomplishment reports related to the dairy industry. It was not evident that the research was a high priority for the dairy industry. We are encouraged that ARS and Dairy Management Inc are partnering to establish a National Dairy Research program. For dairy research, indicating the source of funding from the dairy industry would attest to the relevance and interest of the industry in the research.
4. When there are several accomplishments on the same commodity (especially with the protection of intellectual property), ARS should consider bring together all the technologies and research applicable to that commodity to promote the research and intellectual property *in toto*. This would encourage the private sector to evaluate the value of the total package of research and intellectual property applicable to that commodity.

COMPONENT 1. Quality Characterization, Preservation, and Enhancement

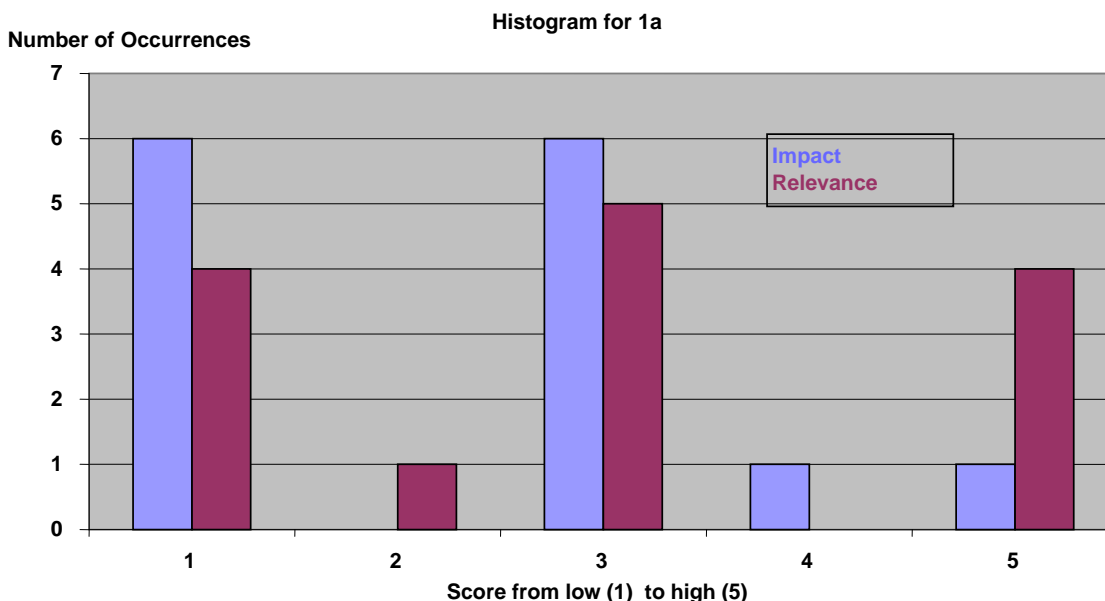
Problem Area 1a. Definition and Basis for Quality

Objectives:

1. Identify attributes that define quality of agricultural products.
2. Develop better understanding of relationships between composition and component molecular structure and end-use quality and function and sensory characteristics.
3. Assess quality trends and needs of agricultural products in global markets.

Review Team Rating:

The mean rating of accomplishments defining quality of agricultural commodities is **Medium-Low Impact** (2.4) with **Medium Relevance** (2.9). The individual accomplishment reports are of variable quality, with many describing interesting research with little realistic commercial application or economic advantage. The review team believes the accomplishments reported within the Problem Area "Definition and basis for quality" generally contribute little impact or relevance to ARS National Program 306, Quality and Utilization of Agricultural Products, and is of low priority in future funding decisions.



Review Team Assessment:

Objective 1 - Although several of the accomplishments identify attributes or specific constituents such as triterpenoids in almonds, limonoid glucosides in citrus crops, pterostilbenes in blueberries, organic acids in pickled vegetables, serine endoproteinases in barley, and moisture in cotton that define the quality of the agricultural commodities, the impacts and relevance of the selected attributes are not clearly presented. Clear comparisons of innovative and traditional approaches to relating selected constituents to end use quality, functionality, and sensory characteristics are necessary. Accomplishment reports directed to specific flavor compounds in tomatoes, wound-healing in potatoes, lycopene in watermelon, soy saponins as analytical standards, and predictions of cotton quality based on the shape of cellulose were perceived as inconsequential with little potential impact or relevance to agricultural productivity or profitability.

Objective 2 -The Team observed that the health promoting potential of citrus limonoids, molecular modeling of collagen in tanning, organic acids and sour flavors, the molecular-genetic basis for wheat kernel texture, and the effect of moisture on cotton functionality are good examples of accomplishments designed to develop a better understanding of relationships between composition and end-use quality, function and sensory characteristics. Evidence of economic advantages and examples of successful commercial applications resulting from the identifying the relationships between constituents of agricultural commodities and their end-use quality would be beneficial.

Objective 3 - The accomplishments addressing wheat kernel quality as one of the primary classifications for world trade is the only obvious accomplishment report addressing the objective to assess quality trends and needs of agricultural products in global markets.

Problem Area 1b. Methods to Evaluate and Predict Quality

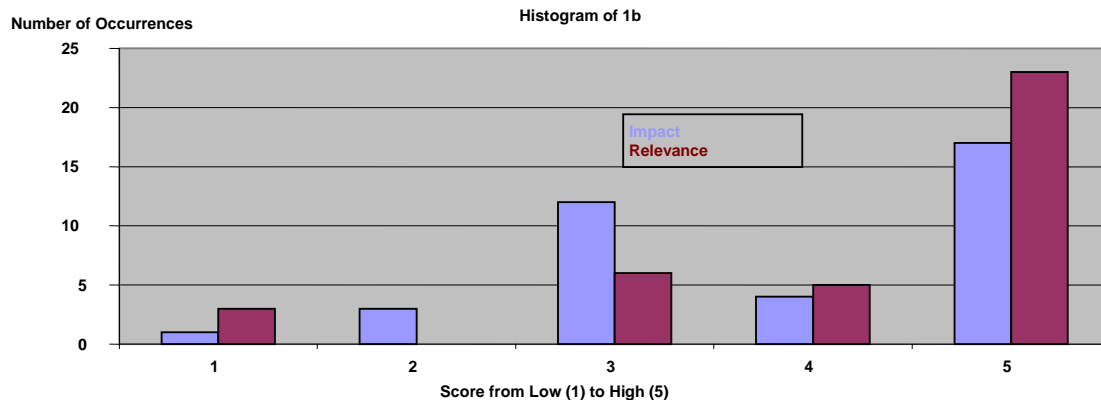
Objectives:

- 1** - Develop rapid, non-destructive methods for detection and measurement of physical/chemical quality attributes and quality defects.
- 2** - Develop automated, high-throughput on-line grading, sorting, and packaging systems for agricultural products.
- 3** - Develop methods to evaluate the performance of sampling plans to measure quality characteristics of agricultural commodities shipped in bulk.

4 - Develop and utilize multispectral techniques, imaging and image analysis, and methods incorporating information technology and artificial intelligence for further improvement of processing and grading.

Review Team Rating:

The mean rating of accomplishments for methods to evaluate and predict quality of agricultural commodities is **Medium Impact** (3.3) with **Medium/High Relevance** (4.1). The individual accomplishment reports range from having little to great impact, as well as little to great relevance to methods to evaluate and predict quality of agricultural products. The success rate for this problem area was very good. The team felt that this problem area needs continued investment to address issues relevant to the stakeholders.



Review Team Assessment:

Objective 1- Methods were developed for rapid, mostly non-destructive, methods for detection and measurement of delayed bitterness in citrus, fruit firmness, sugarcane deterioration, coating permeability, nutrition content, moisture in grains, malting quality of barley, boundary friction of oils, grain quality, FFA in oilseeds, polyphenol oxidase in wheat, objective methods for flax quality, sticky cotton, white specks in cotton fiber, and cotton short fiber content. .

Objective 2 – Methods for automated high-throughput on-line grading, sorting, and packaging systems were developed for agricultural products. Applications included detection of pits in prunes (patent), closed shell pistachios (patent and license), catfish off-flavor indicators, defects in leather, insects in wheat kernels, single kernel specific traits, fungi infected grain, red wheat, cotton lint trash (patent, license), and moisture in cotton bales (patent, license).

Objective 3 - A model was developed to evaluate the performance of sampling plans to reduce almond lot aflatoxin rejection in the EU, to detect quality attributes such as GMA, FM in peanuts, and discolored peanuts, to detect fumonisin in corn, and to detect TCK in export wheat shipments.

Objective 4 – Methods were developed for improvement of processing and grading using NIR, machine vision, acoustic emission, microwave, electrical conductance, and computer models.

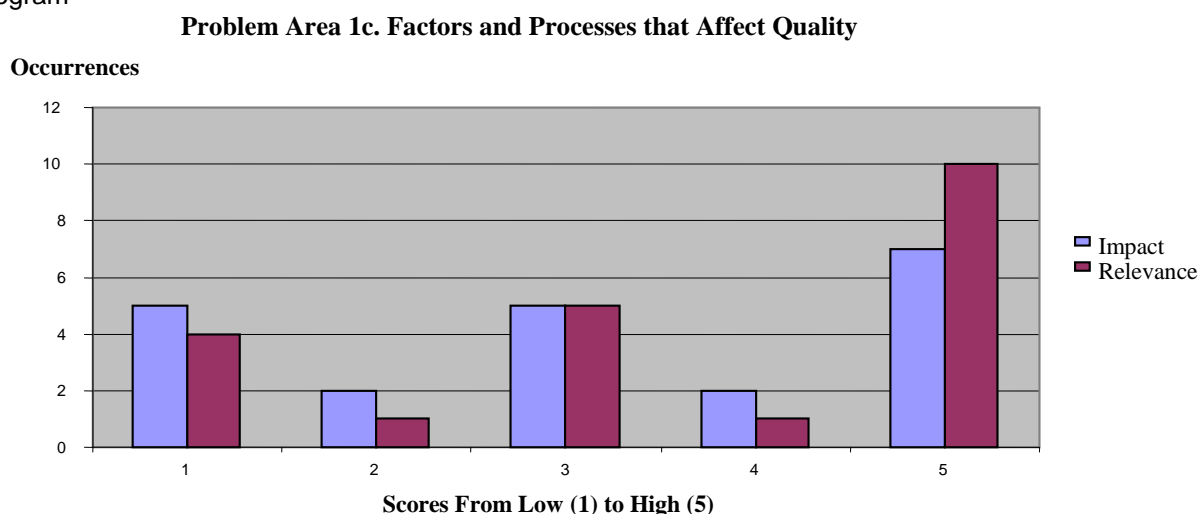
Problem Area 1c. Factors and Processes that Affect Quality

Objectives:

- 1** - Determine influence of pre-harvest factors on quality, including genetics, production practices and environment.
- 2** - Determine influence of post-harvest factors on quality, including storage, handling, grading, and processing.
- 3** - Evaluate effects of safety and environmental protocols on quality of foods.

Review Team Rating:

The mean rating of the accomplishments, factors and processes that affect quality of agricultural commodities, is **Medium Impact** (3.2) with **Medium Relevancy** (3.6). The ratings ranged from having low (1) to high (5) impact as well as low (1) to high (5) relevancy. Histogram



Review Team Assessment:

Objective 1 – Two accomplishments reviewed clearly relate and have a positive impact on pre-harvest factors on quality. These include the cause of apple physiological disorder and the quality assessment of wheat breeding lines. In both cases, the review team commented on the importance of this well-done research and rated both accomplishments as high impact with high relevancy.

Objective 2 – It was the assessment of the review team that one of the accomplishments reviewed, the quality evaluation of new fruit genotypes, had both low impact and low relevance in terms of post-harvest factors on quality, storage, handling, grading, and processing. It is the review team's assessment that this accomplishment is not research and that it questioned ARS's involvement. While a medium low impact and relevance was given to the accomplishment, cheese whey protein enhanced snacks, the same concerns were expressed. Molecular level and the development of cultivars is research, but the marketing of a commercially released product is not.

The review team found that while there is medium relevancy to the accomplishment of flavor changes due to infection by HLB disease, there is low impact. The recommendation given to address HLB was considered not appropriate. The review team determined that the processes affecting leather quality, improved rice milling, peanut curing decision support system development, identity preserved (IP) grain handling, expeller pressed soybean oils, peanut blanching, roasting peanut allergenicity, acceptable restored moisture levels for cotton, and deterioration of cotton quality during storage have medium to high impact and relevancy and are good examples of post-harvest factors on quality, including storage, handling, grading, and processing.

Objective 3 – The review team questioned whether comparing organic to conventionally grown crops is appropriate research. The two accomplishments that fall under this objective make this comparison, and they both received low impact and low relevancy.

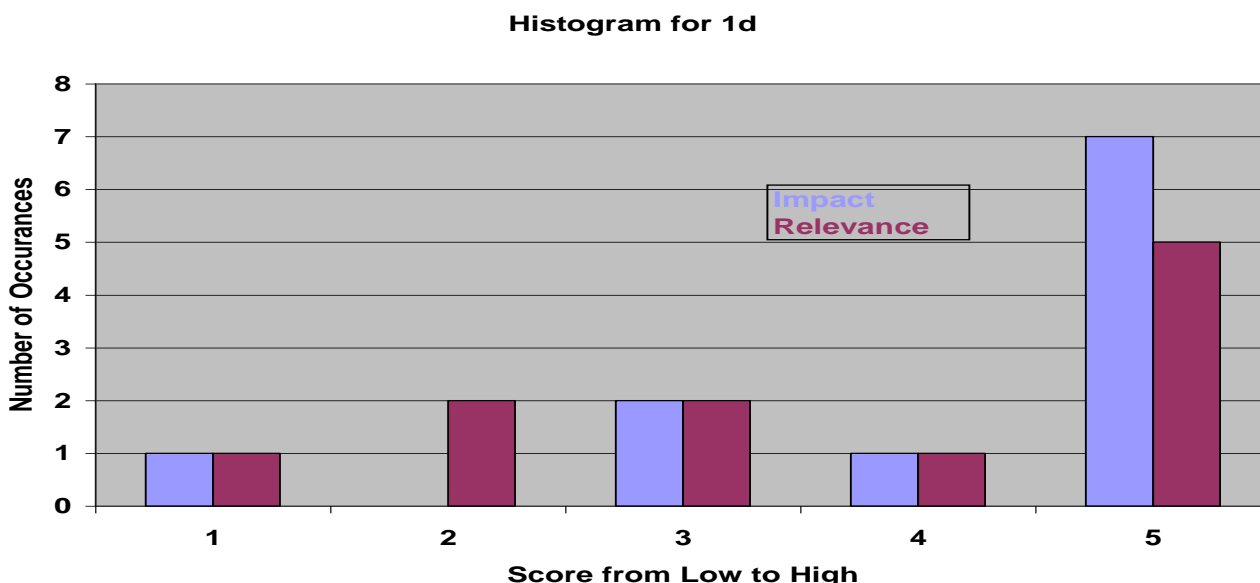
It should be noted that it was the assessment panel's opinion that specific programs should be linked, and there needs to be a larger stakeholder involvement in ARS research programs.

Problem Area 1d. Preservation and/or Enhancement of Quality and Marketability

Objectives:

- 1: Develop strategies to enhance intrinsic product quality and consistency.
- 2: Improve storage technologies which maintain quality and nutrition and increase shelf life.
- 3: Enhance nutritional value of agricultural products.
- 4: Investigate use of antagonistic yeasts and bacteria for antimicrobial effects to enhance safety and reduce spoilage.
- 5: Develop environmentally friendly strategies for plant and animal pathogen control.
- 6: Minimize effects of pest infestation and food-borne risks on trade of agricultural products.

Review Team Rating: Mean rating of 11 accomplishments defining preservation and/or enhancement of quality and marketability is **Medium-High (4.2) for Impact** and **Medium (3.6) for Relevance**.



Review Team Assessment:

General: Given the distribution of accomplishments, consideration should be given to consolidating Problem Area 1d into 1c. It is reasonable to assume from the distribution of ratings (histograms) that projects in both these areas of research are well-aligned to stakeholder interest and input.

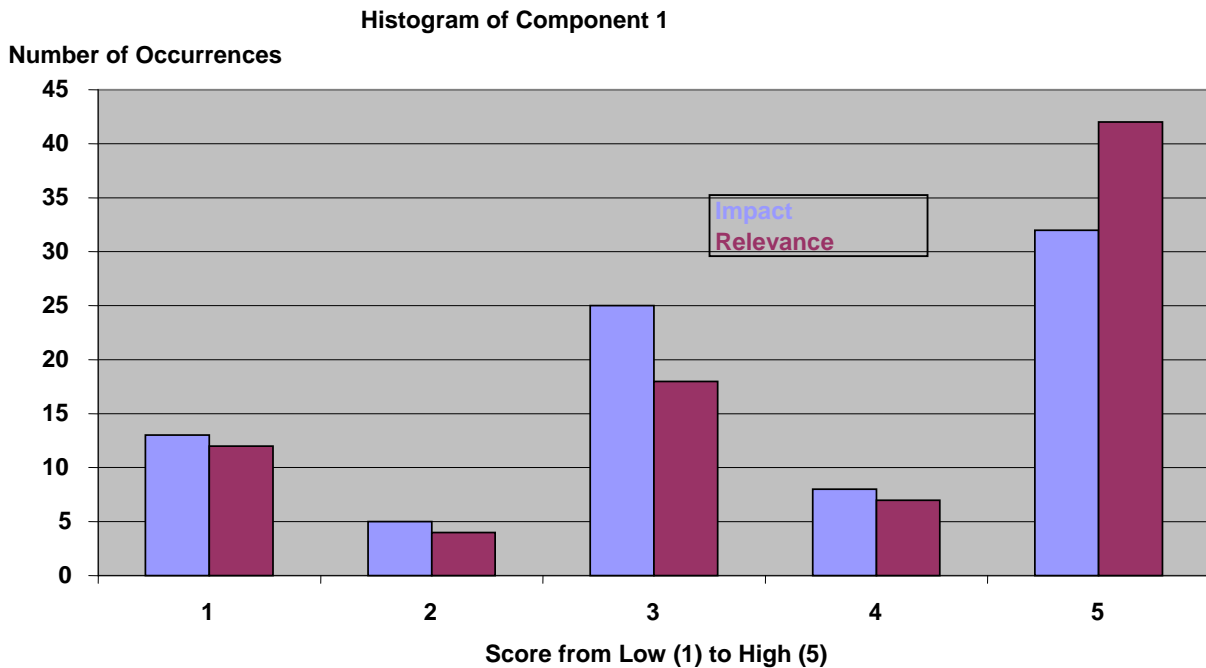
Objective 1- Just over half of the accomplishments fell under this objective and all but one – its write-up lacking in details -- rated HIGH for IMPACT and between MED and HIGH for RELEVANCE. These high ratings encompassed a variety of project themes, ranging from meat tenderization to roller ginning of cotton to fruit quality and indicate a broad emphasis on product quality and consistency.

Objective 2- None of the accomplishments fell into this category.

Objective 3- Two accomplishments, both rated HIGH for both IMPACT and RELEVANCE (Improved phytonutrient contents in melons; potassium to improve cantelope quality).

Objectives 4, 5- None of the accomplishments fell into this category.

Objective 6- An accomplishment rated HIGH for IMPACT (Post-harvest treatments adopted by CA fruit industry) appeared to have good generality but was somewhat sketchy on details. Another accomplishment rated MEDIUM for IMPACT and LOW for RELEVANCE was aimed at an organic-compatible sanitization using peroxyacetic acid.



Component 2. New Processes, New Uses and Value Added Foods and Biobased Products.

Problem 2a. New Product Technology

Fruits, Vegetables, Tree Nuts and Sugar Crops:

Objectives

1 - Identify and characterize functional compounds and components in agricultural commodities and their byproducts

2: Improve understanding of relationship between composition, molecular structure, and physical state and end-use functionality of these compounds and components.

3: Use new knowledge of product properties and component interactions to develop functional intermediates or products

Review Team Rating: The mean rating of accomplishments of new product technology **impact** is **slightly below medium** (2.8) with a slightly **above medium relevance** (3.2).

The distribution determined that 12 projects were rated low and 9 were scored high. In term of relevance 12 were rated highly relevant and 6 were rated with low relevance. The high number of low impact may reflect the early stage in development of the projects. The result is a bimodal distribution of the impact of this section. Because of the bimodal distribution a number of the projects were highly relevant and delivering high impact. Others were low impact and need careful review.



Objective 1- A considerable amount of the effort in objective 1 was the discovery of new or unique ingredients and byproducts. The isolation and pilot scale preparation of citrus limonoids is leading to a pilot scale production. Similarly the polymethoxylated flavones from orange juice processing represents an additional byproduct from the commodity. As with other products such as corn and corn bran products multiple value added by-products of high value are being identified. It is not clear from the write ups that these projects are being coordinated. If they are the cumulative effect would be far more significant. Much of the effort in this objective was around carbohydrates and new or unique applications of by-products or new materials. Although it is early the work on pectin as a matrix for bone repair is interesting and appears to be good science. A concern is that it is not a likely to be a major use of any agricultural product. The development of new polymers from sugar to produce gum Arabic replacements could be of major impact in the food industry if the new polymers will match the performance of gum Arabic. Some reports in this section were too brief to be able to assess properly specifically the work on low glycemic ingredients and cyclic polysaccharides were of little value. More detailed descriptions are needed to assess the projects and their contribution to the objectives. The research on new lipid products particularly those for industrial uses exhibit considerable promise. The work on estolides is exciting particularly if a non-castor or ricin free castor source of fatty acids is available.

Objective 2 - Understanding molecular interactions and is key to the development of new technology. The development of Fantesk through jet cooking is an example of apply basic molecular understanding with processing to develop unique chemical interactions that result in new and useful ingredients and delivery systems. The modification of lipids to basic ingredients for polyester manufacture offers good promise and new application of oils. Research on structured lipids for caloric control represents excellent chemistry but the ultimate utility of the products is questioned by the panel. The development of active wound dressings from cotton was considered of great significance.

Objective 3 - Several of the reports indicted good progress toward end use functionality of the materials being studied. The development of the guayale based latex is the culmination of several years of work. There is very likely a market for the product. The biobased fungicide work is one of the highlights of the objectives. If this can be brought to fruition it will impact a new paradigm in protection of foods and agricultural products will emerge. Similarly the use of soy in the development of rubber based products represents a new outlet for soy.

Several projects have reported CRADAs and industrial partnerships reflecting commercial interest. There are also cases of successful commercialization. It is frequently difficult to measure the extent of commercial interest.

In some instances the projects are severely limited because the ultimate cost of production is too high. More consideration needs to be given to cost of production of ingredients or products including how costs fit in the balance of materials. When two or more products are recovered the potential for sharing cost of production can be advantageous.

The panel was concerned that there were several projects in this section that would be considered technology and may not be appropriate to the mission and objectives. Specifically the continuous casting technology for fruit and vegetable wraps and the fruit bars were successful in that the technologies were used by industry but the panel questioned the importance to ARS. Similar concerns were expressed about extruded snacks from whey.

Generally most of the projects are reaching the objectives as stated. The panel would like to see more evidence of coordination between projects that appear to be reported separately.

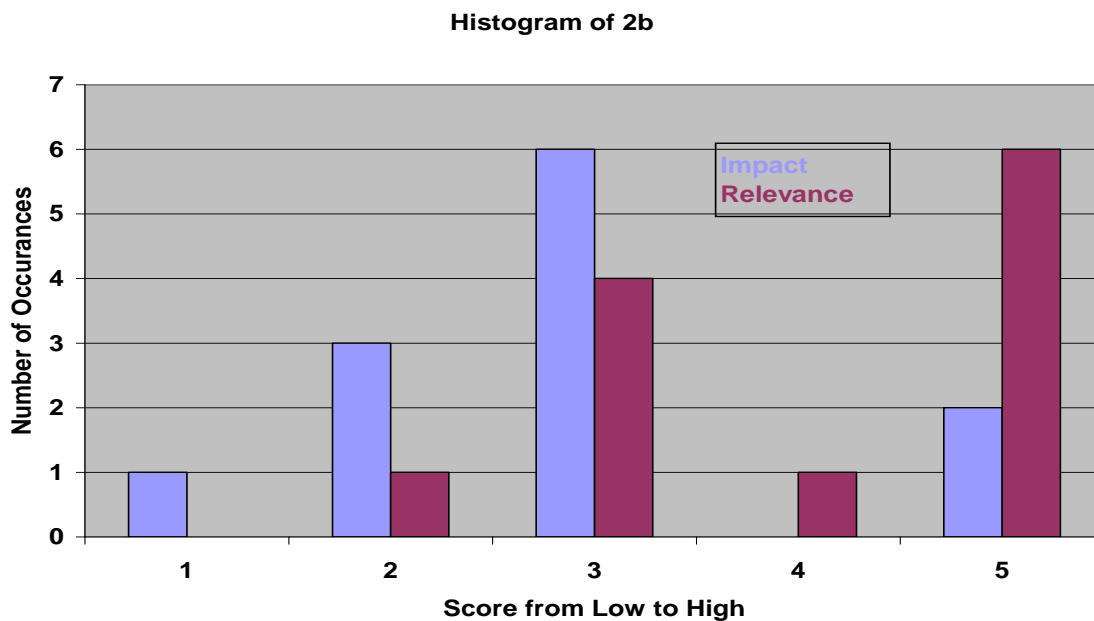
Problem Area 2b. New Uses for Agricultural By-products

Objectives:

1. Identify and characterize by-product components for potential value-added products.
2. Convert low value agricultural residues into higher value products.

Review Team Rating:

Problem Area 2b was represented by only 12 accomplishment reports. The Team assessed **Impact** as having a **Medium** rating (2.9) and **Relevance** as having a **Medium-High** rating (4.0). One third of Impact ratings were below Medium and only one Relevance rating was below Medium as reflected in the Histogram below.



Review Team Assessment:

85% of the Problem Area 2b were directed at Objective 2) above: two of these are very advanced toward commercialization (cotton-based Hydromulch and ion exchange materials from plant byproducts) while the remaining eight are at earlier (sometimes much earlier) research and development stages. These are targeted programs are at very early stages and therefore have low ratings.

Area 2b does not make up much of the NP306 effort and the projects are by definition opportunistic. The two successes are assessed as having High Relevance because they utilize otherwise ignored waste materials that would have simply become a waste disposal problem rather than a commercial opportunity. These waste streams are smaller volume or truly difficult to utilize, the implicit assumption is that very large streams of more accessible materials will flow to lignocellulosic biofuels.

Problem Area 2c. New and Improved Processes and Feedstocks

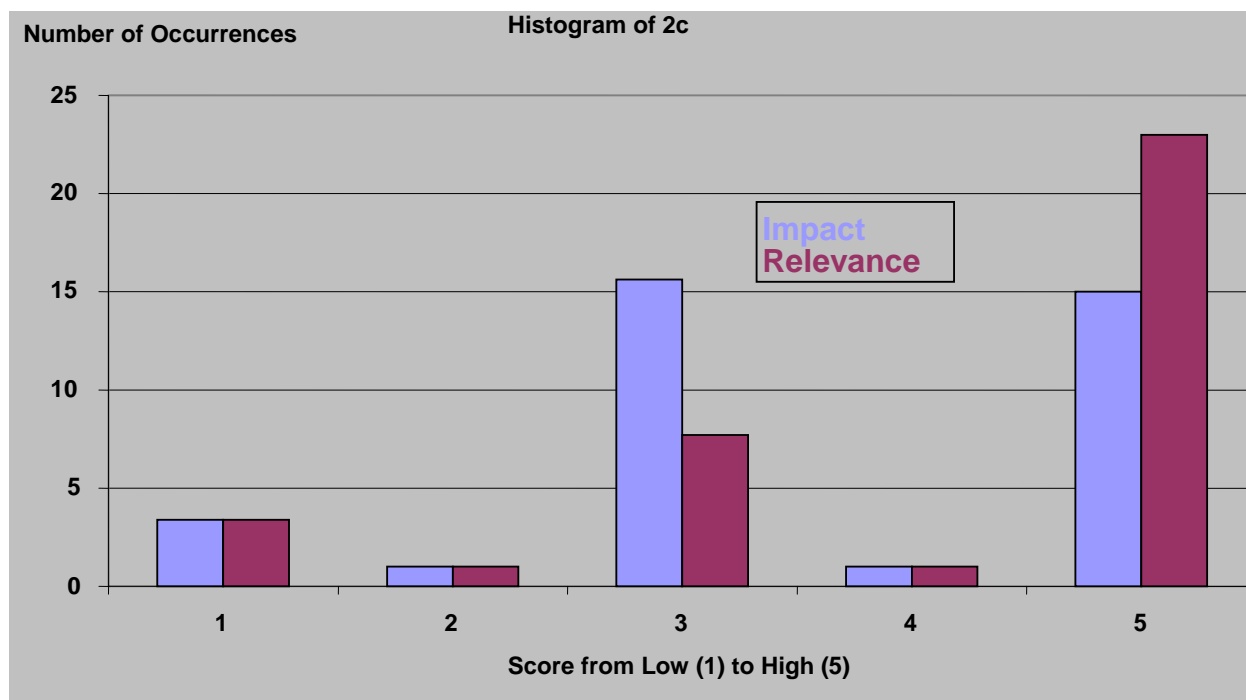
Objectives:

1. Develop improved and new techniques and technologies to convert agricultural products into value-added foods and biobased products.
2. Improve/develop processes and technologies that are environmentally benign.

Review Team Rating: The mean accomplishment ratings for new and improved processes and feedstocks were **Medium Impact** (3.6) and **Medium-High Relevance** (4.1). By commodity type, projects were predominately in the Cereals, Oilseeds, and Novel Crops category. The number of development projects versus process improvement projects was nearly equal. Relevance ratings tended to be somewhat higher than impact, reflecting the panel's view that while most projects targeted relevant issues, impacts were not yet demonstrated or were not communicated sufficiently in the reports.

While the success rate was relatively good for this problem area, questions were raised about the proper role of ARS in developing new products or improving existing processes. This role was accepted by the review panel when there was strong industry support and evidence of commercialization or strong potential towards commercialization. However, product development in absence of strong commercial draw is more difficult to justify for future resource priority.

Accuracy of the assessment was affected by the inconsistency of information quality provided by the reports. Decisions were often made by drawing on panel member's indirect knowledge of the area. The high ratings have good confidence from the review panel, whereas medium and low ratings may be influenced by absence of knowledge from the reports.



Review Team Assessment:

Objective 1 – The highest rated accomplishments tended to solve long-standing, recognized issues in their industry, demonstrated strong industry collaboration, and/or provided commercialization opportunities when economics become more favorable. Examples include modifying wool to remove skin irritation and shrinkage to reach new consumer markets; developing a series of biobased home products with improved ecological footprint and economics for industry partner; converting agricultural residues into packaging materials; processes for producing new rice-based ingredients and products with CRADA partners; a new phytase with enhanced activity to improve nutrient efficiency and decrease environmental impact; healthy grain-based food ingredients; commercialization of biobased lubricants from soy; new skincare products from vegetable oil; multiple commercial applications of a starch-vegetable oil dispersion; and cotton/flax blends that provide enhanced fiber characteristics and a competitive advantage in the global textile market. Examples that didn't demonstrate linkage to industry support or economic benefits were "green" plasticizers from oxygenated vegetables oils and high phytosterol corn fiber oil.

Objective 2 – Process improvements with environmental benefits also tended to have strong industry support or recognized industry need. Examples include an effective dehairing system that improves hide quality, reduces pathogen potential in meat, and reduces chemical and time requirements for leather tanning; utilizing soapstock for conversion to oleo-chemicals, reducing a major underutilized by-product; developing an effective economic model for the corn wet milling process that can be applied universally to improve process efficiency; and effective pretreatments that improve "union dyeing" of wool-cotton blends to increase utilization of these textiles. An examples that did not connect with industry need was application of infrared technology to fruit/vegetable preservation.

Histogram of the Program's Accomplishments:

Histogram of Component 2

